GEOTECHNICAL ENGINEERING STUDY

Proposed HCT Building - Schurman Way
Woodland, Washington

Prepared for:
Schlecht Construction, Inc.
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Project No. G17-0511
{June 2011}

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Vancouver, WA 98662

June 17th 2011
G17-0511

Subject: **Geotechnical Study - Proposed HCT Building**
Schurman Way, Woodland, Washington

Hello Mark,

We are pleased to submit our report titled "Geotechnical Engineering Study, Proposed HCT Building, Vancouver, Washington." This report presents the results of our field exploration, selective laboratory tests and engineering analyses.

Based on the results of this study, it is our opinion that construction of the proposed light industrial building and associated driveway/parking area is feasible from a geotechnical standpoint, provided recommendations presented in this report are included in the project design.

We appreciate the opportunity to have been of service to you and look forward to working with you in the future. Should you have any questions about the content of this report, or if we can be of further assistance, please call.

Respectfully Submitted,
GE Services Inc.,

Donald J. Bruno, EG
Engineering Geologist

Van W. Olin, PE
Project Engineer

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INTRODUCTION

General

This report presents the results of the geotechnical engineering study completed by GE Services Inc. (GE Services) for the proposed light industrial building for the HCT Corporation. The general location of the site is shown on the *Topographic Vicinity Map, Figure 1.* At the time our study was performed, the site and our exploratory locations were approximately as shown on the *Site Plan, Figure 2.*

The purpose of this study was to explore subsurface conditions at the site, and based on the conditions encountered provide geotechnical recommendations for the proposed construction.

Project Description

Based on the information that was provided to us by Schlecht Construction it is our understanding that HCT plans to develop the subject site with a two-story building that will provide approximately 12,110 square feet of floor space. The building footprint will be about 9,360 square feet. The second level will provide about 2,750 square feet. A future addition to be constructed adjacent to the west side of the newly proposed building will provide 10,000 square feet of floor space.

The building will be constructed with a steel frame, metal siding and a slab on grade floor. It is our understanding that the subject site will require about three to five feet of fill to achieve the desired design grade. Improvements will also include an asphalt paved driveway, twenty-one (21) parking spaces and a gravel storage yard.

If any of the above information is incorrect or changes, we should be consulted to review the recommendations contained in this report. In any case, it is recommended that GE Services perform a general review of the final design.

SITE CONDITIONS

Surface

The subject site encompasses approximately three acres and slopes gently downward from the east to the west. The site was covered with grass, blackberries and several deciduous trees. A wetlands area was observed at the northwest side of the site. The property is bordered to the north and south by existing industrial facilities, to the east by Thurman Way and to the west by a wetlands area.

Subsurface

For this study the site was explored by excavating three test pits at the approximate locations shown on the *Site Plan, Figure 2.* All soil was classified following the *Unified Soil Classification System (USCS).* A USCS Legend is included as Plate A1. A description of the field exploration methods is included in Appendix A.

The following is a generalized description of the subsurface conditions encountered. In our test pit excavations we encountered one foot of topsoil that consists of soft to very soft Silt (ML), underlain by soft to firm Silt and Clayey Silt with lenses of fine sand to a depth of about three to four feet below the surface. Below the silt we encountered medium dense clean Sand (SP) to a depth of about six and one half feet below the surface. Below the sand we encountered soft to firm elastic silt (MH) with fine sand to the maximum exploration depth of nine feet below the existing ground surface.

The test pits could not be excavated below nine feet due to heavy groundwater seepage, which caused the cohesion less sand layer to collapse. Please refer to the test pit logs, Plates A2 through A4, for a more detailed description of the conditions encountered at each location explored.

Groundwater

Heavy groundwater seepage was encountered in our test pits at depths ranging from two and one-half to three feet below the existing ground surface during the time of our field exploration. It is important to note that groundwater conditions are not static; fluctuations may be expected in the level and seepage flow depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, the groundwater level is higher and seepage rate is greater in the wetter winter months (typically October through May).

General Regional Geology

General information about geologic conditions and soil in the vicinity of the site was obtained by reviewing the Geologic Map of Washington-Southwest Quadrant, WA. State Department of Natural Resources, (Geologic Map GM-34, 1987) and the Geologic Map of the Vancouver Quadrangle, Washington & Oregon, (DLNR), Open File Report 87-10. These maps provide general information about geologic units in the Woodland, Washington area.

Our review of existing geologic information indicates that soils west of Woodland consist of Quaternary sedimentary alluvial deposits. The alluvium consists predominantly of inter-bedded layers of fine grained silt and fine to medium grained sand deposited along the flood plains of the Columbia River. In some areas organic silt is prevalent as organic material was buried and decomposed in backwater low energy environments.

LABORATORY TESTING

Laboratory tests were conducted on representative soil samples to verify or modify the field soil classification of the units encountered, and to evaluate the general physical properties as well as the engineering characteristics of the soils encountered. The following provides information about the testing procedures performed on representative soil samples and the general condition of subsurface soil conditions encountered:

- *Moisture Content (ASTM-D2216-92)* tests were performed on representative samples. In the upper layer of silt the moisture content ranges from thirty-two to thirty-five percent (32% - 35%). The intermediate layer of clean sand has a soil moisture content that ranges from twenty to twenty-eight percent (20% - 28%). The deepest layer of elastic Silt has a moisture content that ranges from twenty-six to twenty-nine percent (26% - 29%).

- Grain Size Analyses (ASTM-D1140-97) were performed on representative samples at the subject site. These tests confirm that subsurface soils, from three to six and one half feet below the surface consist predominantly of clean Sand. The percent fines or percent passing the #200 sieve in the sandy soil ranges from one to five percent (1% to 5%).

- In-Situ Soil Density (ASTM-D4564-93) by the sleeve method was performed on representative samples to determine the wet and dry density of native soil. The in-situ density provides a relative indication of soil support characteristics. The dry and wet densities of the upper layer of silt is one hundred and one (101) pounds per cubic foot (pcf) and seventy-three (73) pcf, respectively. The dry and wet densities of the lower layer of clayey silt are one hundred and twenty-two (122) and ninety-four (94) pcf, respectively.

- *Atterberg Limits (ASTM-D4318-95)* were performed on representative samples to determine the "water-plasticity" ratio of in-situ soil. This test also provides an indication of relative soil strength as well as the potential for soil volume changes with variation in moisture content. Testing indicates the upper layer of silt has a low plasticity.

- *Consolidation Testing (ASTM-D2435-04)* were performed on representative samples to determine the "water-plasticity" ratio of in-situ soil. This test also provides an indication of relative soil strength as well as the potential for soil volume changes with variation in moisture content. Testing indicates a relatively low degree of consolidation under the anticipated loads.

Laboratory testing confirms that subsurface soil consist of a variety of soils. Silt, clean Sand and Elastic Silt were encountered in our test pits. The predominance of these soils, exclusive of the clean sand is sensitive to changes in moisture content. Moisture sensitive soils are discussed in more detail in the *Site Preparation and Grading* section of this report.

The results of laboratory tests performed on specific samples are provided at the appropriate sample depth on the individual test pit logs and in *Appendix B, Laboratory Testing.* However, it is important to note that some variation of subsurface conditions may exist. Our geotechnical recommendations are based on our interpretation of these test results.

SEISMIC HAZARD EVALUATION

The following provides a seismic hazard evaluation for the subject site. Our evaluation is based on subsurface conditions encountered at the site during the time of our geotechnical study, a review of geotechnical studies by others, a review of applicable geologic maps (Washington Department of Natural Resources, Geologic Map of Washington - Southwest Quadrant, 1987), a review of Ecology well logs and the International Building Code (IBC 2006) guidelines.

In general, supportive soil at the subject site consists of soft to firm silt and loose to medium dense sand. As previously discussed heavy groundwater seepage was encountered in our test pits about two to three feet below the surface. The referenced geologic map indicates that no known active faults are located within one-mile of the subject site.

In general, soils encountered to a depth of nine feet below the site are classified as a type "E" soil in accordance with "Site Class Definitions (IBC 2006, Section 1613, Table 1613.5.2, page 303). For more detail regarding soil conditions refer to the test pit logs in Appendix A of this report.

Liquefaction:

Structures are subject to damage from earthquakes due to direct and indirect action. Shaking represents direct action. Indirect action is represented by foundation failures and is typified by liquefaction. Liquefaction occurs when soil loses all shear strength for short periods of time during an earthquake. Ground shaking of sufficient duration results in the loss of grain to grain contact as well as a rapid increase in pore water pressure. This causes the soil to assume physical properties of a fluid.

To have potential for liquefaction a soil must be loose, cohesion-less (generally sands and silts), below the groundwater table, and must be subjected to sufficient magnitude and duration of ground shaking. The effects of liquefaction may be large total settlement and/or large differential settlement for structures with foundations in or above the liquefied soil.

Based on the soft to medium dense soil conditions encountered and the presence of a near surface groundwater table, it is likely that soil liquefaction would occur at the subject site during a moderate to strong seismic event.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our study, it is our opinion that the site can be developed provided the geotechnical recommendations contained in this report are incorporated into the final design.

During our field exploration we encountered soft to firm saturated soils and medium dense clean sand in the vicinity of the proposed building area to a depth of approximately nine feet below the existing ground surface. As previously discussed heavy groundwater seepage was observed at about two to three feet below the surface. Our review of Ecology water well logs in the vicinity of the subject site indicates that the static groundwater level ranges from about four to ten feet below the existing ground surface.

Due to the non-cohesive soil conditions and a shallow water table there is a moderate to high potential for soil liquefaction during a seismic event. Therefore, we recommend that the building be supported on conventional shallow spread footings or thickened floor slabs that bear upon a geo-grid reinforced "gravel mat". This type of foundation system will reduce the potential for settlement and act to bridge softer areas below foundations.

Additionally, we suggest that the foundation and floor slab be provided with additional steel reinforcement to increase foundation rigidity. Flexible connections should also be used for utilities to account for potential differences in settlement during a seismic event.

It is important to note that during a strong seismic event there is potential that some areas below the conventional footings and mat reinforced floor slabs could temporarily liquefy and cause some settlement. The degree of settlement is dependent on the duration of the seismic event and will dictate the amount of foundation and/or building repair that may be required.

By constructing the proposed building on a reinforced "gravel mat", the potential for settlement during a seismic event will be significantly reduced. However, if no degree of risk can be assumed by the owner then it will be necessary to support the entire building and floor slabs on a deep foundation system. A deep pile foundation system can be provided at the owner's request.

Details for a conventional spread foundations or thickened floor slabs with a geo-grid reinforced gravel-mat are discussed in more detail in the *Site Preparation & Grading* section as well as the *Foundation* sections of this report.

As previously discussed, the near surface soil encountered at the site consists of moisture sensitive silt. Therefore, earthwork grading and foundation construction may be difficult during the wet winter and spring seasons. Based on this condition we suggest that grading and foundation construction be completed during the drier summer and fall seasons.

This report has been prepared for specific application to this project only and in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area for the exclusive use of HCT Corporation and their representatives. This report, in its entirety, should be included in the project documents for information to the contractor. No warranty, expressed or implied, is made.

Site Preparation and Grading

The site shall be stripped and cleared of all vegetation, organics matter and any other deleterious material. Stripped material should not be mixed with any soils to be used as fill. We suggest that the upper one foot of soft saturated topsoil be removed from the building and pavement areas prior to the placement of structural fill. Stripped soil could potentially be used for topsoil at landscape areas after removing vegetation and screening out organic matter.

Building Area:

After clearing and stripping the site the geo-grid reinforced gravel mat can be constructed at the building area. The mat consists of a eighteen-inch thick layer of gravel with geo-grid placed below and above the gravel section. The mat should extend a minimum of two feet beyond the building footprint.

The soil exposed after stripping should be static compacted with a segmented pad roller if soil moisture conditions will allow. A geo-grid is then placed on the exposed soil surface followed by eighteen inches of one and one-quarter inch (1-1/4") minus clean angular gravel. The gravel should be compacted following the structural fill procedures described below. A second layer of geo- grid is placed over the compacted gravel to complete the mat.

Fill can then be placed over the "gravel mat" to the desired design elevation. We recommend that a minimum of six inches of crushed rock be placed and compacted above the mat.

It should be noted that this type of "gravel mat" foundation system is designed to provide a more rigid and homogeneous base below foundations as well as bridge potential soft pockets that may be encountered. It is possible that soil conditions may be considerably more saturated and softer than anticipated. If poor support conditions are encountered across the predominance of the excavated area then it may be necessary to over excavate and replace additional unsuitable soil with compacted structural fill.

A tri-axial geo-grid designed for foundation improvement applications can be used for the mat system. We recommend that a geo-textile representative provide recommendations for which geo-grid product will work best for the proposed application. The installation and compaction procedures should be observed by a representative from our office.

Moisture Sensitive Soils:

Field observations and laboratory testing indicates that on-site native soil is moisture sensitive due to the percentage of fine-grained material (silt). As such in an exposed condition moisture sensitive soil can become disturbed during normal construction activity, especially when in a wet or saturated condition. Once disturbed, in a wet condition, these soils will be unsuitable for support of foundations, floor slabs and pavements. Therefore, where soil is exposed and will support new construction, care must be taken not to disturb their condition. If disturbed soil conditions develop, the affected soil must be removed and replaced with structural fill. The depth of removal will be dependent on the depth of disturbance developed during construction.

Structural Fill:

Structural fill is defined as any soil placed under buildings, pavements or any other load bearing-areas. Structural fill placed under footings and floor slabs should be placed in thin horizontal lifts not exceeding eight inches, and compacted to a minimum ninety-five percent (95%) of its maximum dry density (Modified Proctor). The fill material should be placed within three percent of the optimum moisture content.

Fill under driveway and parking area pavements should also be placed in lifts approximately eight inches thick and compacted to a minimum of ninety percent (90%) of its maximum dry density (modified proctor), except for the top twelve (12) inches which should be compacted to 95 percent of the maximum dry density. Recommendations for pavement sections are described in the *Pavement Areas* section of this report.

We recommend that structural fill consist of a well graded granular material having a maximum size of two inches and no more than five percent (5 %) fines passing the #200 sieve, based on the ¾ inch fraction. It is recommended that any structural fill planned for on-site use, be submitted for approval prior to import.

Exclusive of the base rock compacted below all foundations, slabs and pavements any soil could potentially be used as structural fill. However, it is important to note that the material must be free of organics, non-expansive and compacted within two percent of the soils optimum moisture content. Extensive aeration and mixing may be required to work soil to a compactable condition. Moisture sensitive silts may not be compactable during wet weather conditions.

The placement and compaction of structural fill should be observed by a representative from our office to verify that fill has been placed and compacted in accordance with the approved project plans and specifications.

Foundations

Based on the subsurface soil conditions encountered, preliminary building design criteria and assuming compliance with the preceding *Site Preparation and Grading* section, the proposed structure can be supported on conventional shallow spread footings bearing on a structural fill mat.

Footings for the one level sections of the building should be at least twelve (12) inches in width and should extend to a minimum depth of eighteen (18) inches below the exterior sub grade or twelve inches below the top of the interior floor slab surface. Individual spread footings or continuous wall footings providing support for the proposed building may be designed for a maximum allowable bearing capacity value of two- thousand five hundred (2500) pounds per square foot (psf).

These basic allowable bearing values are for dead plus live loads and may be increased one-third for combined dead, live, wind, and seismic forces. It is estimated that total and differential footing settlements for the relatively light buildings will be approximately three-quarters and one-half inch, respectively. Lateral loads can be resisted by friction between the foundation and the supporting sub grade or by passive earth pressure acting on the buried portions of the foundation. For the latter, the foundations must be poured "neat" against the existing soil or back filled with a compacted fill meeting the requirements of structural fill.

- Passive Pressure = 300 pcf equivalent fluid weight
- Coefficient of Friction = 0.40

We recommend that all footing excavations be observed by a representative of GE Services prior to placing forms or rebar, to verify that sub grade support conditions are as anticipated in this report, and/or provide modifications in the design as required.

Slab On Grade

The building floor slab may be supported on structural fill as described in the Site Preparation and Grading section of this report. Any disturbed soils must be re-compacted prior to pouring concrete. As previously discussed some of the subsurface soils have the potential for liquefaction during a seismic event. Therefore, we suggest that additional steel reinforcement be incorporated in the floor slab to provide a rigid platform which will effectively reduce settlement during an earthquake. Slab on grade floors should be designed by the project structural engineer based on the anticipated load conditions and sub grade support characteristics.

Temporary Excavations

The following information is provided solely as a service to our client. Under no circumstances should this information be interpreted to mean that GE Services is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

In no case should excavation slopes be greater than the limits specified in local, state and federal safety regulations. Based on the information obtained from our field exploration and laboratory testing, the site soils expected to be encountered in excavations, soft to firm Silt (ML), loose to medium dense clean Sand (SP) with freely seeping groundwater would be classified as Type "C" soils by OSHA guidelines.

Therefore, temporary excavations and cuts greater than four feet in height, should be sloped at an inclination no steeper than 1-1/2H : 1V (horizontal:vertical) for type "C" soils. If this inclination, or flatter, cannot be constructed or if excavations greater than ten feet in depth are required, temporary shoring may be necessary.

The shoring would help protect against slope or excavation collapse, and would provide protection to workmen in the excavation. If temporary shoring is required, we will be available to provide shoring design criteria, if requested.

Site Drainage

Groundwater seepage was encountered at two to three feet below the surface during the time of field exploration. It is likely that groundwater may be encountered in utility trench excavations depending on the planned design depth. Isolated areas of groundwater seepage may also be encountered in foundation excavations during construction.

If seepage is encountered in utility trench or foundation excavations during construction, the bottom of the excavation should be sloped to one or shallower sump pits. The collected water can be pumped from these pits to a positive and permanent discharge, such as a nearby storm drain. Depending on the magnitude of seepage it may be necessary to interconnect the sump pits by a system of connector trenches.

We recommend that the appropriate locations of subsurface drains, if needed, be established during grading and excavation operations by this office, at which time the seepage areas may be more clearly defined. The site should be graded so that surface water is directed off the site. Water should not be allowed to stand in any area where buildings or slabs are to be constructed. Final site grades should allow for drainage away from the building foundations. The ground should be sloped at a gradient of three percent for a distance of at least ten feet away from the building.

Footing Drains should be installed around the perimeter of the proposed building, just below the invert of the footing with a gradient sufficient to initiate flow. Under no circumstances should the roof down spouts be connected to the footing drain system.

We recommend that clean outs be installed at several accessible locations to allow for the periodic maintenance of the footing drain system. Details for the footing drain have been included as *Figure 3, Footing Subdrain Detail.*

Utility Support and Back Fill

Based on the conditions encountered, the soil to be exposed by utility trenches should provide adequate support for utilities. Utility trench backfill is a concern in reducing the potential for settlement along utility alignments, particularly in pavement areas. It is also important that each section of utility line be adequately supported in the bedding material. The back fill material should be hand tamped to ensure support is provided around the pipe haunches.

Fill should be carefully placed and hand tamped to about twelve inches above the crown of the pipe before any compaction equipment is used. The remainder of the trench back fill should be placed in lifts having a loose thickness of eight inches. A typical trench backfill section and compaction requirements for load supporting and non-load supporting areas is presented on *Figure 4, Utility Trench Backfill Detail.* Trench back fill may consist of imported granular fill provided the material is placed and compacted near the optimum moisture content. Material to be used as backfill should be submitted to our laboratory at least one week prior to construction so that we can determine the suitability of the soil and provide a laboratory proctor for field density testing.

Pavement Areas

The durability of driveway and parking area pavements is related in part to the condition of the underlying sub grade. To provide a properly prepared sub grade for pavements, we recommend the sub grade be treated and prepared as described in the *Site Preparation and Grading* section of this report. It is possible that some localized areas of soft, wet or unstable sub grade may still exist after this process. Before placement of any base rock, the sub grade should be compacted with suitable compaction equipment. Yielding areas that are identified should be excavated to firm material and replaced with compacted two inch-minus clean-crushed rock.

The following pavement section is recommended for the proposed driveway and parking areas:

- Three inches of Asphalt Concrete (AC) over ten inches of compacted Crushed Rock Base (CRB) material (optional: over a geo-grid consisting of Tensar BX1100 or equivalent).

The geo-grid should be placed directly on the sub grade surface of the driveways and parking areas prior to placement of base rock. Geogrids have been suggested as an option. Appropriate geotextiles have been designed to increase the strength of the sub grade and extend pavement life.

Asphaltic Cement (AC) and Crushed Rock Base (CRB) materials should conform to WSDOT specifications. All base rock should be compacted to at least 95 percent of the ASTM D-1557-91 laboratory test standard. We recommend that a minimum of eight inches of compacted CRB be placed below all exterior slabs. Exterior concrete slabs that are subject to vehicle traffic loads should be at least six inches in thickness. It is also suggested that nominal reinforcement such as "6x6-10/10" welded wire mesh be installed, near midpoint, in new exterior concrete slabs and paving. Fiber mesh concrete may be used in lieu of welded wire mesh.

Additional Services & Construction Monitoring

GE Services will be available to provide consultation services related to review of the final design to verify that the recommendations within our purview have been properly interpreted and implemented in the approved construction plans and specifications.

A representative from our office will be available to attend a pre-construction meeting to discuss and/or clarify all geotechnical issues related to the proposed project.

In addition, it is suggested that this office be retained to provide geotechnical services during construction to observe compliance with the design concepts and project specifications and to allow design changes in the event subsurface conditions differ from those anticipated.

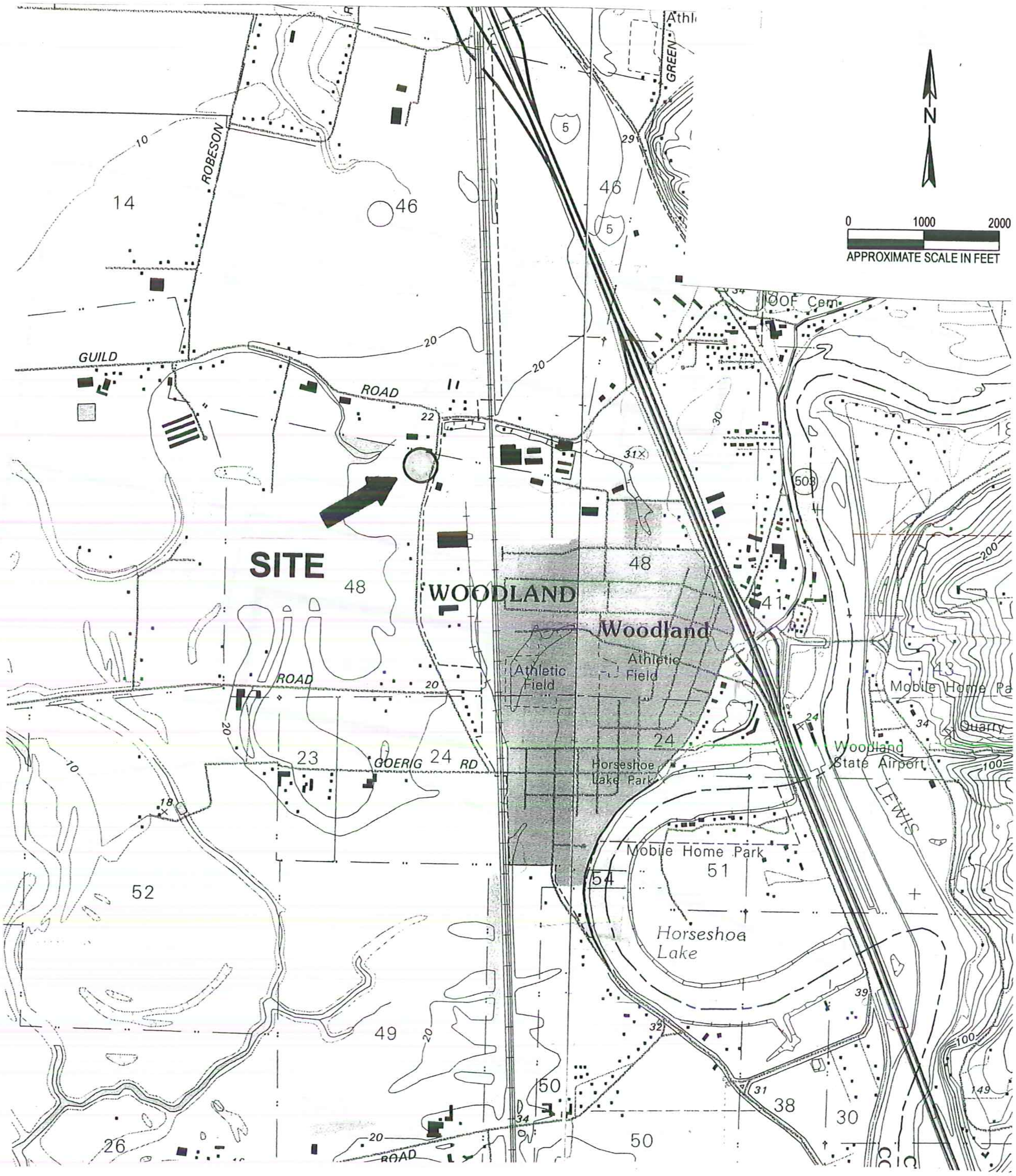
Our construction services would include monitoring and documenting the following:

- *Site grading, foundation excavations, construction of a "gravel-mat" foundation*
- *The installation of foundation drainage systems*
- *Utility trench backfill & compaction*
- *Compressive strength testing of foundation and floor slab concrete*
- *Pavement geo-grid installation and base rock compaction*
- *Pavement sub-grade proof rolling*
- *Density testing of asphalt pavements*

LIMITATIONS

Our recommendations and conclusions are based on the site materials observed, selective laboratory testing, engineering analyses, the design information provided to GE Services and our experience as well as engineering judgment. The conclusions and recommendations are professional opinions derived in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. No warranty is expressed or implied.

The recommendations submitted in this report are based upon the data obtained from the test pits. Soil and groundwater conditions test pits may vary from those encountered. The nature and extent of variations may not become evident until construction. If variations do appear, GE Services Inc. should be requested to reevaluate the recommendations contained in this report and to modify or verify them in writing prior to proceeding with the proposed construction.



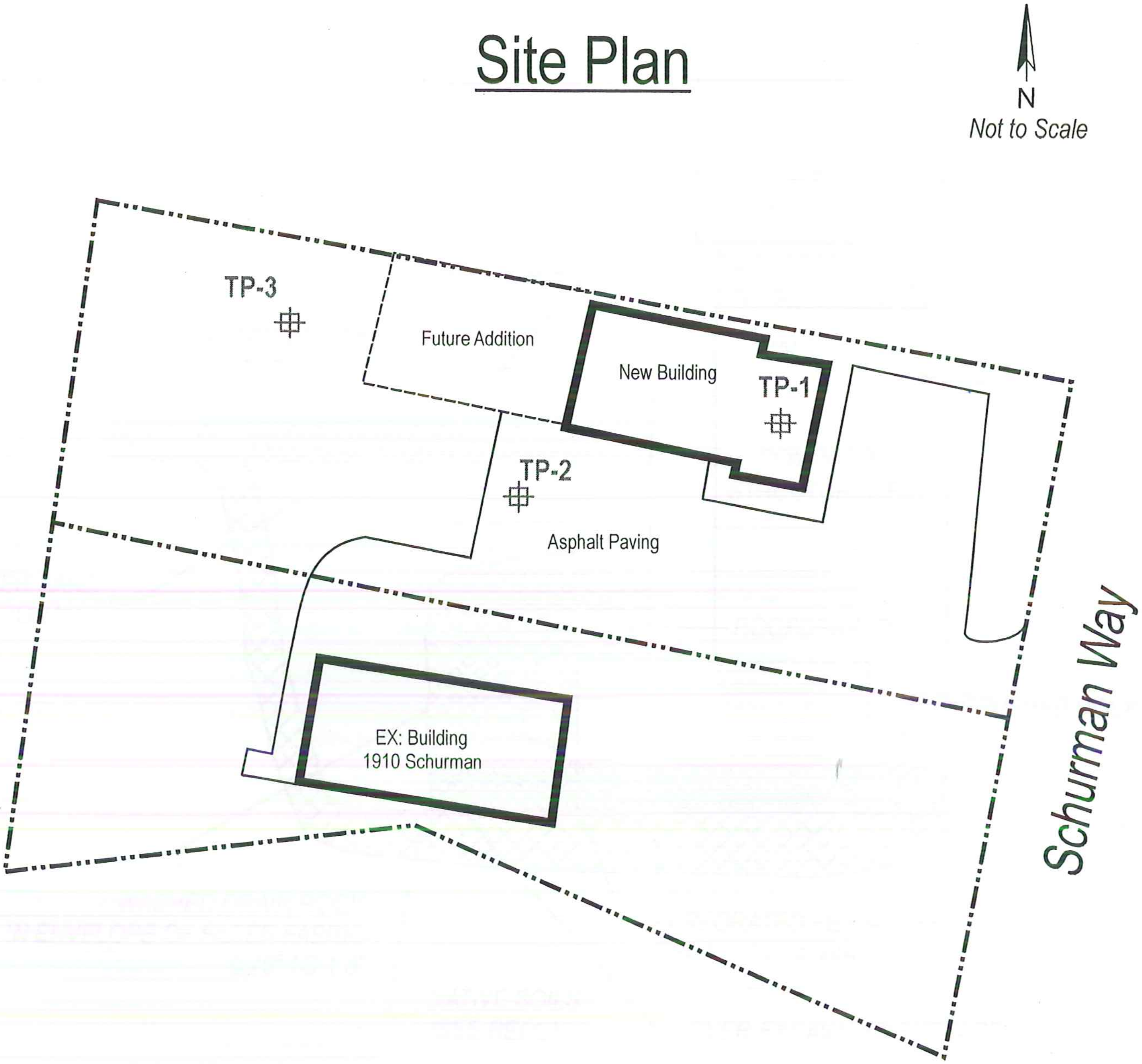
VICINITY TOPOGRAPHIC MAP

Source: USGS 7.5 x 1.5 Quad, Woodland, WA -1990 & Deer Island, OR-WA

GE Services
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	Schlecht/HCT Building	DRAWN:	SC
PROJECT:	Shurman Way Woodland, Washington	DATE:	6/21/11
		FIGURE:	1
		PRO. #:	G17-0611

Site Plan



Legend

TP-3
⌖ Approximate Test Pit Location

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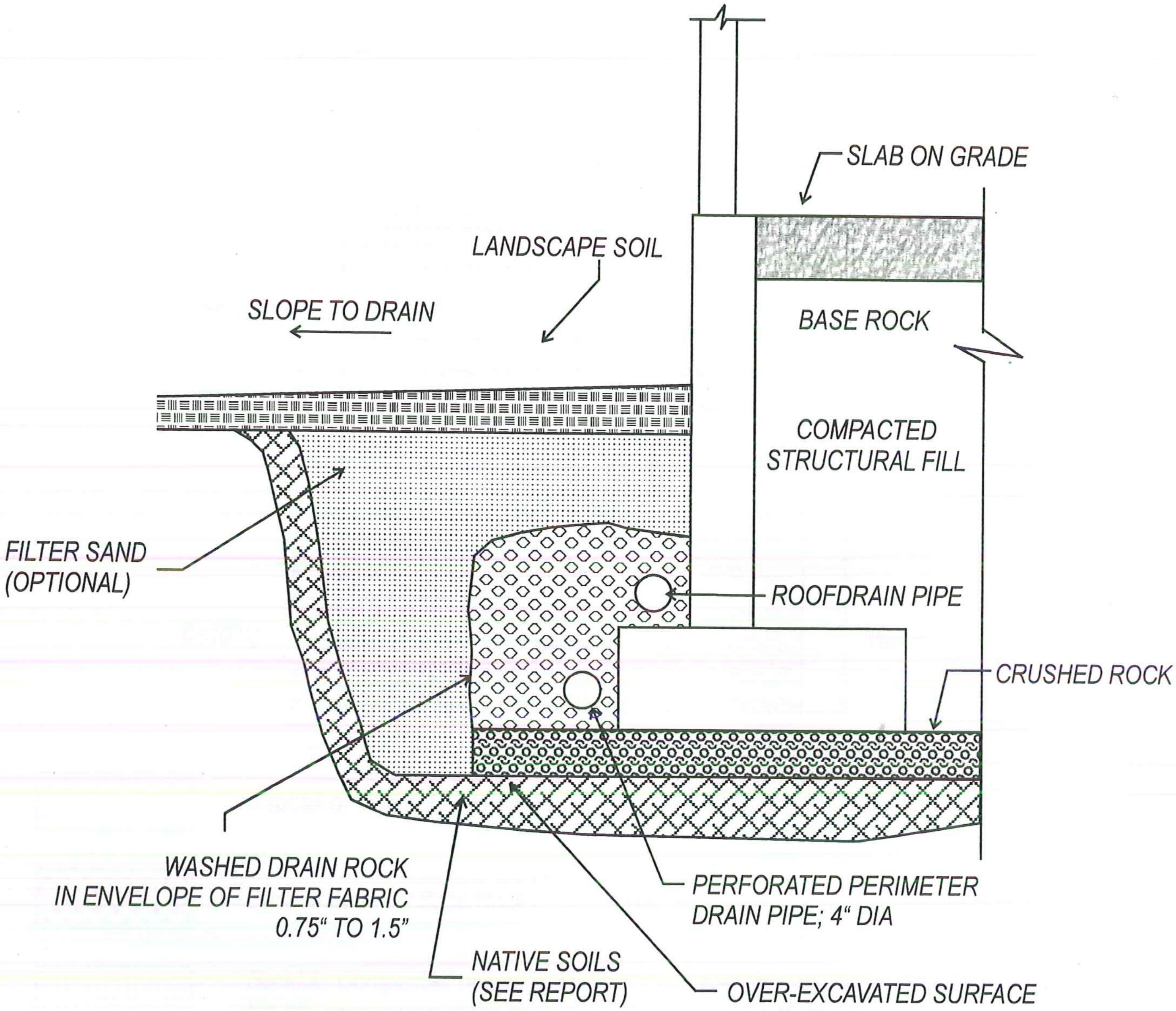
CLIENT: Schlecht / HCT Building
PROJECT: Schurman Way
Woodland, Washington
DRAWN: SC
DATE: 6/16/11
FIGURE: 2
PRO. #: G17-0611



NOTES:

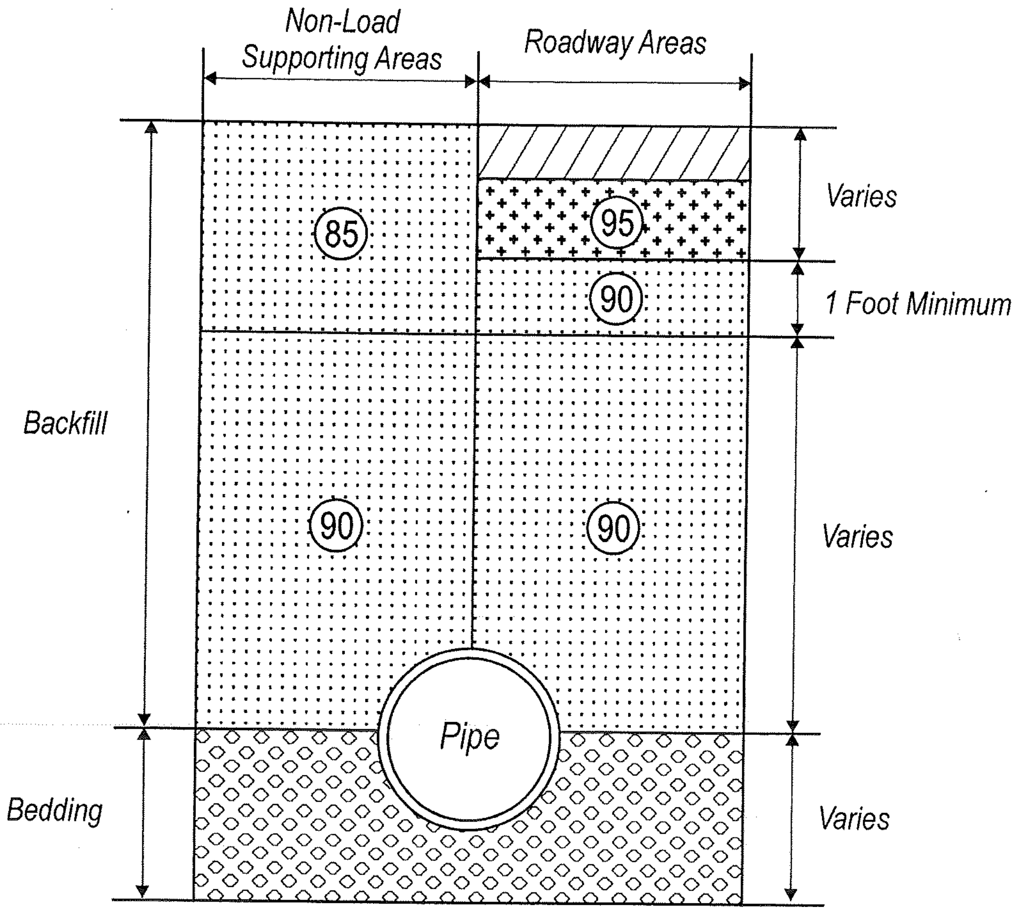
1. PERFORATED OR SLOTTED RIGID PVC PIPE WITH A POSITIVE DRAINAGE GRADIENT
2. FILTER SAND - FINE AGGREGATE FOR PORTLAND CEMENT; SECTION 9=03.1(2)
3. FILTER FABRIC OPTIONAL IF FILTER SAND USED

TYPICAL FOOTING SUBDRAIN DETAIL

Not to Scale

GE Services
GEOTECHNICAL & ENVIRONMENTAL CONSULTANTS

CLIENT:	Schlecht / HCT Building	DRAWN: SC
PROJECT:	HCT Building Schurman Way Woodland, Washington	DATE: 6/21/11 FIGURE: 3 PRO.#: G17-0511



LEGEND

▨ Asphalt or Concrete Pavement

✚ Base Material or Base Rock

⁙ Backfill: Compacted on-site soil or imported select fill material as described in the site preparation of the general Earthwork Section of the attached report text.

(90) Minimum percentage of maximum Laboratory Dry Density as determined by ASTM Test method D1557 (Modified Proctor),unless otherwise specified in the attached report text.

◇ Bedding Material: Material type depends on type of pipe and laying conditions. Bedding should conform to the manufacturer's recommendations for the type of pipe selected.

UTILITY TRENCH BACKFILL DETAIL

Not to Scale

GE Services GEOTECHNICAL & ENVIRONMENTAL CONSULTANTS	*CLIENT:* Schlecht / HCT Building	*DRAWN:* SC
	PROJECT: HCT Building Schurman Way Woodland, Washington	*DATE:* 6/22/11 *FIGURE:* 4 *PRO. #:* G17-0511

APPENDIX A

(FIELD EXPLORATION)

FIELD EXPLORATION

Our field exploration was performed on May 19th 2011. Subsurface conditions at the site were explored by excavating three test pits to the maximum depth of nine feet below the existing ground surface. The test pits were excavated using a track-hoe.

The approximate test pit locations were determined by taping from existing property corners. The locations of these test pits should be considered accurate only to the degree implied by the method used. These approximate locations are shown on the *Site Plan, Figure 2.*

The field exploration was monitored by a GE Services representative, who classified the soils that we encountered and maintained a log of each test pit, obtained representative samples, and observed pertinent site features. Representative soil samples were placed in closed containers and returned to the laboratory for further examination and testing.

All samples were identified using the Standard Classification of Soils for Engineering Purposes (ASTM D2487-93) in accordance with the Unified Soil Classification System (USCS), which is presented on Plate A1. Logs of the test pits are presented in Appendix A. The final logs represent our interpretations of the field logs and the results of the laboratory tests on field samples. The stratification lines on the logs represent the approximate boundaries between soil types. In fact, the transitions may be more gradual.

UNIFIED SOIL CLASSIFICATION SYSTEM
LEGEND

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
Coarse Grained Soils More Than 50% Material Larger Than No 200 Sieve Size	Gravel and Gravelly Soils More Than 50% Coarse Fraction Retained on No 4 Sieve	Clean Gravels (little or no fines)	⁘	GW / gw	Well-Graded Gravels, Gravel-Sand Mixtures Little or no Fines
			●	GP / gp	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines
		Gravels with Fines (appreciable amount of fines)	▥	GM / gm	Silty Gravels, Gravel-Sand-Silt Mixtures
			▨	GC / gc	Clayey Gravels, Gravel-Sand-Clay Mixtures
	Sand and Sandy Soils More Than 50% Coarse Fraction Passing No 4 Sieve	Clean Sand (little or no fines)	○	SW / sw	Well-graded Sands, Gravelly Sands Little or no Fines
			▒	SP / sp	Poorly-Graded Sands, Gravelly Sands Little or no Fines
		Sands with Fines (appreciable amount of fines)	▥	SM / sm	Silty Sands, Sand-Silt Mixtures
			▨	SC / sc	Clayey Sands, Sand-Clay Mixtures
Fine Grained Soils More Than 50% Material Smaller Than No 200 Sieve Size	Silts and Clays	Liquid Limit Less than 50	▥	ML / ml	Inorganic Silts and Very Fine Sands, Rock Flour, Silty-Clayey Fine Sands; Clayey Silts w/ slight Plasticity
			▨	CL / cl	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean
			▦	OL / ol	Organic Silts and Organic Silty Clays of Low Plasticity
	Silts and Clays	Liquid Limit Greater than 50	▥	MH / mh	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils
			▨	CH / ch	Inorganic Clays of High Plasticity, Fat Clays
			▨	OH / oh	Organic Clays of Medium to High Plasticity, Organic Silts
Highly Organic Soils			░	PT / pt	Peat, Humus, Swamp Soils with High Organic Contents

Topsoil	░	Humus and Duff Layer
Fill	▦	Highly Variable Constituents

GE Services
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	Schlecht/HCT Building	DRAWN:	SC
PROJECT:	Shurman Way Woodland, Washington	DATE:	6/16/11
		PLATE:	A1
		PRO. #:	G17-0611

LOG OF TEST PIT **TP-1**

ELEVATION: **~ 20 feet**

EXPLORATORY EQUIPMENT: **TRACK HOE**

DATE: **5/27/11**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
		6 - 8" grass						
1	●	**Silt,** trace sand (topsoil)	▒	Dark Brown	Wet	Very Soft	35	-
2 3	☒	**Silt (ML)** w/ lenses of fine sand	▥	Light Brown	Wet	Firm	32	-
4 5 6	● ●	▼ clean, fine to medium **Sand (SP)**	░	Grey	Water Bearing	Medium Dense	28 20	5
7 8	●	elastic **Silt (MH)** w/ fine sand	▥	Grey Brown	Wet to Saturated	Firm	29	-

Bottom of test pit at 8.0 feet below existing ground surface { test pit collapse }.
Heavy groundwater seepage encountered at 2.5 feet below ground surface.

▼ *Groundwater level*

GE Services
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	Schlecht / HCT Building	DRAWN:	SC
PROJECT:	HCT building Shurman Way Woodland, Washington	DATE:	6/21/11
		PLATE:	A2
		PRO. #:	G17-0511

LOG OF TEST PIT TP-2

ELEVATION: **~ 20 feet**

EXPLORATORY EQUIPMENT: **TRACK HOE**

DATE: **5/27/11**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
		6 - 8" grass						
0 - 1		**Silt** (topsoil)	░	Dark Brown	Wet	Very Soft	-	-
1 - 4	☒ (2 - 2.5) ● (3) ▼ (2.5)	clayey **Silt (ML)** trace sand { wet density - 100 pcf / Dry density - 75 pcf }	‖	Light Brown	Wet	Soft to Firm	34 28	-
4 - 6	● (5)	Clean **Sand (SP)**	▒	Grey Brown	Water Bearing	Loose to Medium Dense	27	1
6 - 9	● (7.5)	elastic **Silt (MH)** w/ fine sand	‖	Mottled Grey Brown	Wet to Saturated	Soft to Firm	26	-

Bottom of test pit at 9.0 feet below existing ground surface { test pit collapse }.

Heavy groundwater seepage encountered at 2.5 feet below ground surface.

▼ *Groundwater level*

GE Services
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	Schlecht / HCT Building	DRAWN:	SC
PROJECT:	HCT building Shurman Way Woodland, Washington	DATE:	6/21/11
		PLATE:	A3
		PRO. #:	G17-0511

LOG OF TEST PIT **TP-3**

ELEVATION: **~ 20 feet**
EXPLORATORY EQUIPMENT: **TRACK HOE**
DATE: **5/27/11**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION 8' blackberries	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
1		**Silt** (topsoil)	▒	Dark Brown	Wet	Soft	-	-
2 3	▼	**Silt (ML)** w/ trace sand	▥	Light Brown	Wet	Firm	-	-
4 5		Clean **Sand (SP)**	░	Grey Brown	Water Bearing	Medium Dense	-	-
6 7 8 9		elastic **Silt (MH)**	▥	Grey Brown	Saturated	Firm	-	-

Bottom of test pit at 8.0 feet below existing ground surface { test pit collapse }.
Heavy groundwater seepage encountered at 3.0 feet below ground surface.

▼ *Groundwater level*

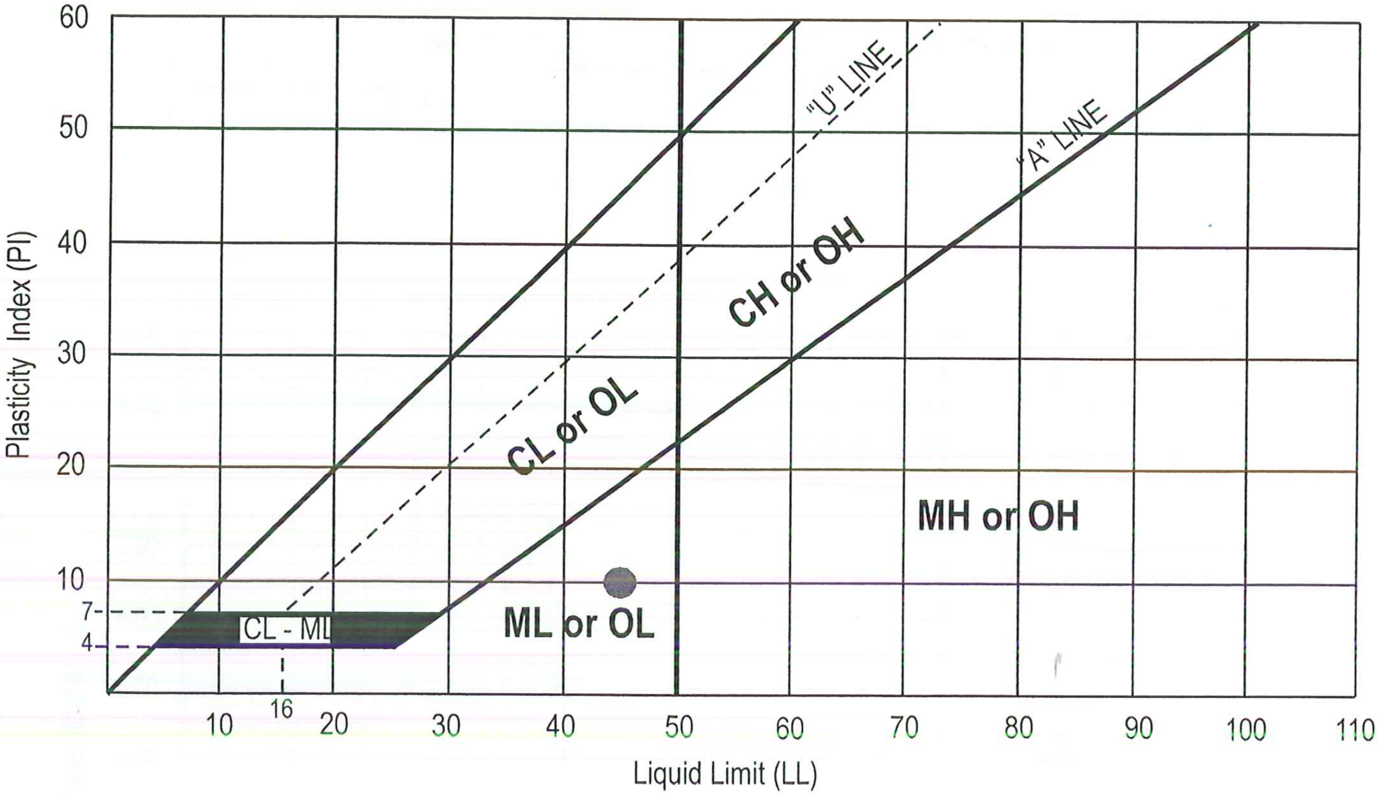
GE Services
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	Schlecht / HCT Building
PROJECT:	HCT building Shurman Way Woodland, Washington
DRAWN:	SC
DATE:	6/21/11
PLATE:	A4
PRO. #:	G17-0511

APPENDIX B

(LABORATORY TESTING)

ATTERBERG LIMITS
ASTM D427 & D4318



● TP - 2 @ 2.5' feet - Silt (ML)

Liquid Limit (LL) = 45 / Plastic Limit (PL) = 35
Plastic Index (PI) = 10

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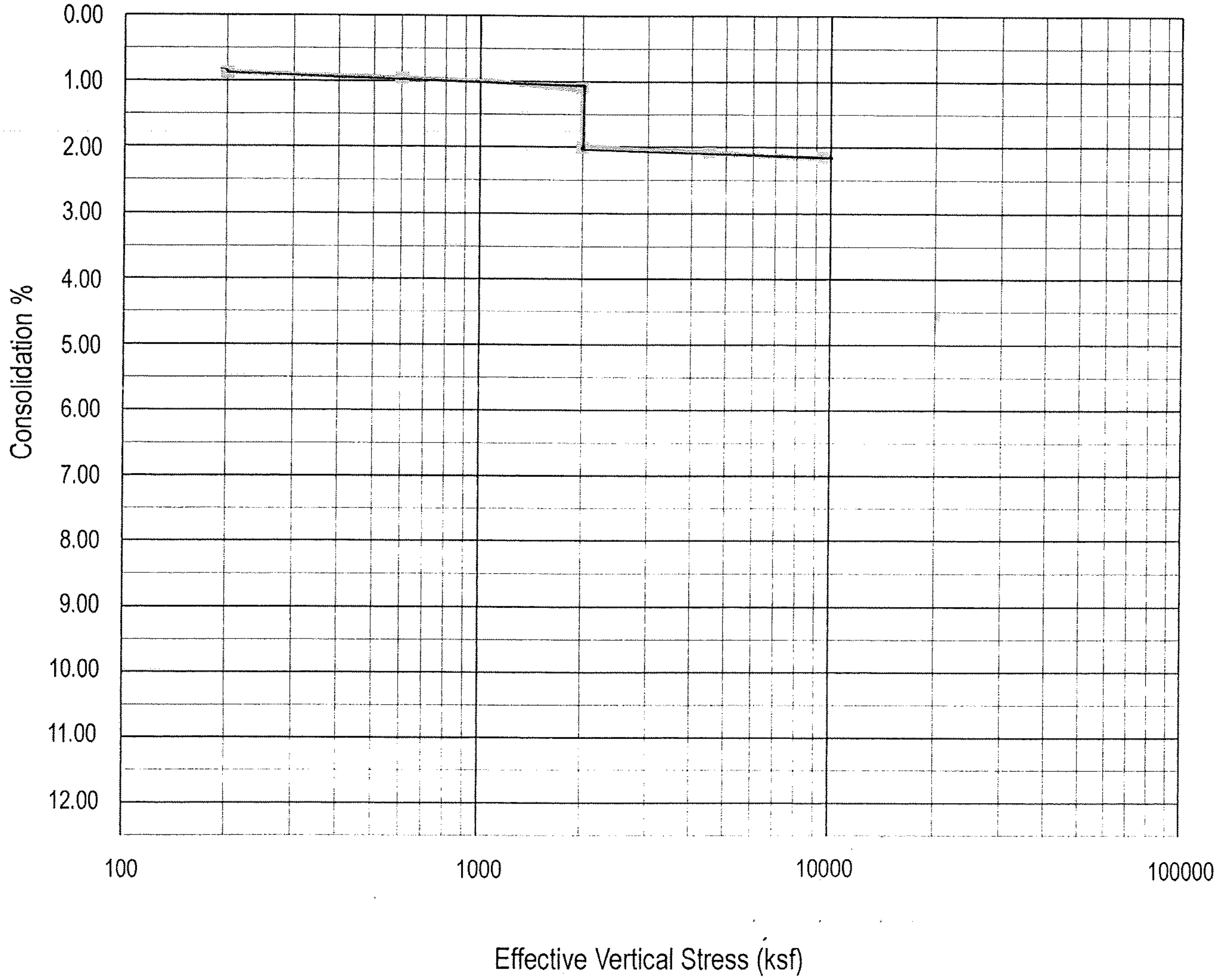
CLIENT:	Schlecht / HCT Building	*DRAWN:*	JM
PROJECT:	Schurman Way Woodland, Washington	*DATE:*	6/16/11
		PLATE:	B1
		PRO. #:	G17-0611

CONSOLIDATION GRAPH

MATERIAL SOURCE: TP-1	*TEST DATE:* 6/13/11
SAMPLE DEPTH: 6.5' feet - (SM)	*TEST METHOD:* ASTM D2435
WET DENSITY : 122.2 pcf	*DRY DENSITY :* 94.3 pcf

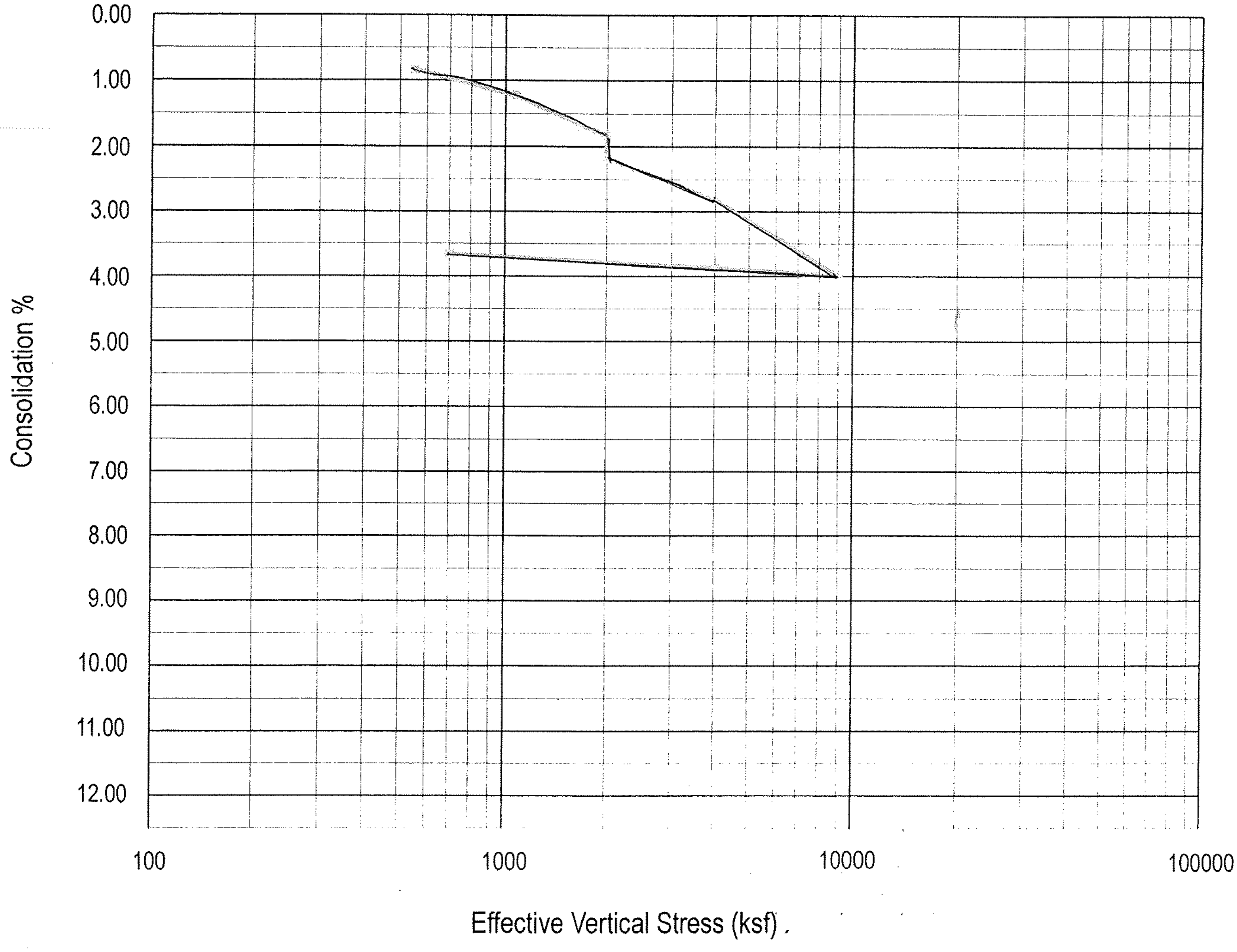


GE Services
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT: Schlecht / HCT Building	*DRAWN:* JM	
PROJECT: Schurman Way Woodland, Washington	*DATE:* 6/21/11	
	PLATE: B2	
	PRO. #: G17-0611	

CONSOLIDATION GRAPH

MATERIAL SOURCE: TP-2	*TEST DATE:* 6/13/11
SAMPLE DEPTH: 2.5' feet - (MH)	*TEST METHOD:* ASTM D2435
WET DENSITY : 102.4 pcf	*DRY DENSITY :* 71.3 pcf



GE Services
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CLIENT: Schlecht / HCT Building		*DRAWN:* JM
PROJECT: Schurman Way Woodland, Washington		*DATE:* 6/21/11
		PLATE: B3
		PRO. #: G17-0611

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